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In any field, it is appropriate to periodically reflect on what practice has been substantiated by research in the field, as well as what implications that research may have for future endeavors. This research review of the field of aquatics for individuals with disabilities discusses problems with definition of the field and narrows this definition for more detailed consideration. Using a database spanning over half a century and containing over 900 items classified as related to adapted aquatics, the quality, content, and substance of research in adapted aquatics are considered for reflection. Finally, recommendations are made for future research directions to better support growth in the field, as well as health and wellness of individuals with disabilities.

Reflecting on aquatics for individuals with disabilities first requires more detailed definition of terms. In the broadest sense, aquatics for individuals with disabilities could mean adapted aquatics, hydrotherapy, and/or aquatic therapy. More specifically, aquatics for individuals with disabilities might include instructional swim, competitive swim, aquatic exercise, recreational aquatics, small craft, lifesaving and water safety, and water learning. Any one of these subgroups could be further subdivided into more specific activities. For example, aquatic therapy could be broken down into Bad Ragaz, Watsu, Ai Chi, and a host of other therapeutic modalities. Furthermore, aquatics for individuals with disabilities can be defined by the specific population groups participating, aquatic exercise for individuals with arthritis, for example, or sailing for individuals who are paraplegics. The wide variety of possible combinations provides almost unlimited potential for accumulating extensive research in the field; however, this wide variance appears, to the contrary, to have resulted in a very limited body of research determined knowledge from which little consensus can be drawn.

In addition, establishing research quality criteria is also problematic. Within the population of individuals with disabilities, even within a population that is disability specific, obtaining a matching population sample is almost impossible, as no two disabilities present in exactly the same manner. In addition, finding even a similarly-homogeneous sample of the population in sufficient enough numbers to be statistically relevant is also very difficult. The more severe the disability, the smaller the population with this disability. Keeping these factors and potential

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limitations in mind, quantifying research in aquatics for individuals with disabilities was undertaken.

Methodology

For purposes of compiling research results in aquatics for individuals with disabilities, limitations had to be placed on the definition of the field. For the purposes of this analysis, "aquatics" is used in the broadest participatory activity sense; however, hydrotherapy research, that is, the investigation of medically prescribed, diagnosis specific, manipulative therapy performed in a physical therapy setting such as in a hubbard tank, was excluded. This exclusion extended to hydrotherapy for post injury rehabilitation, as well as post surgery rehabilitation. Research on hydrotherapy performed in a purely medical setting is more appropriately classified as medical research, not aquatic.

Aquatic exercise effects on specific disability populations, when examined outside of a clinical setting, were included. The term aquatic therapy has come to be a much broader participatory definition than hydrotherapy. Therefore, some aspects of aquatic therapy were included where the activity appeared to be more of an aquatics participation endeavor than medical research performance.

With these parameters in place, the Grosse Adapted Aquatics Database (Grosse, 2009) was accessed. At the time of access in January 2009, this database contained 909 entries, dating from the 1930s through 2008. The keyword *research* was used to sort items in the database and 60 items were identified which met the criterion established related to nonmedical, participatory purpose of activity in water. Items found represented 14.93% of the total database contents.

To maintain an appropriate size sample of research, no evaluation of research design was done. All articles fitting the general parameters of aquatics for individuals with disabilities were included; however, while a case history is a viable form of research, no case histories were included. Rationale for exclusion of case histories was that few case histories found met any appropriate research standards. Most were first person accounts of personal experiences, parental testimonies, and varying forms of narration of program results with no further evaluative measures.

All 60 articles included for review met the following criterion.

- Each documented some form of aquatic participation by an individual or individuals with a disability.
- Participation documentation did not represent research in a totally medical research setting.
- Participation documentation did not represent a generic case history.
- Classification of research was applied for entry into the Grosse Adapted Aquatics Database (Grosse, 2009).

Once the articles were identified from the database search, they were analyzed based on the following:

- Year of publication.
- Disability population represented.
- Research topic focus as related to aquatics.

• Relationship to other research identified for this review.

Conclusions regarding research on aquatics for individuals with disabilities are drawn from this analysis. Based on the analysis findings and conclusions, recommendations are made regarding future directions in research for individuals with disabilities.

Articles Reviewed

Articles reviewed distributed across decades as shown in Table 1. Research topics, as represented by these articles, were grouped into the following categories relating to aquatics and the specific topic pertinent to individuals with disabilities, as shown in Table 2.

Disability categories, as represented by the articles reviewed were grouped into categories as represented in Table 3.

Results

Decade Distribution of Articles

Regarding the decade distribution of research, clearly the majority of the research has been completed since 1980. This correlates with general development in the field. The year 1977 marked the debut of the American Red Cross adapted aquatics program (ARC). Before that time, swimming for the handicapped was the predominant term applied to this aquatic field, with published information and programs stemming largely from physical therapy related swim programs for combat injured soldiers (Convalescents, 1945).

The greatest amount of research in the broad field of aquatics for individuals with disabilities is taking place in our current decade. While this increased research interest and activity is very encouraging, it also makes it very difficult for anyone seeking research substantiation for program organization and implementation, because current research must find a publishing outlet in order for it to

Table 1 Article Distribution by Decade

Decade	Number of Articles
1930–1940	None
1941–1950	None
1951–1960	1
1961–1970	3
1971–1980	1
1981–1990	9
1991–2000	7
2001–2008	37
Articles not dated.	2

become a matter of record for a review such as this. Aquatic-related scholarly journals are not plentiful.

Regarding the decade distribution of research topics, there has been a gradual shift from research regarding instructional techniques and accomplishment potential of individuals with disabilities to research regarding physiological benefits of aquatic participation. The category *Teaching and Learning of Skills* has the greatest distribution of research over all decades. How individuals learn to function in water, as well as how to facilitate that functioning, has always been a concern of

Table 2 Article Distribution by Topic, Frequency, and Decade

Research Topic	Number of Articles	Decade
Cognition	1	2001–2008 (1)
Competition	1	2001–2008 (1)
Equipment	2	1991–2000 (2)
Exercise Performance	8	1961–1970 (1) 1981–1990 (4) 2001–2008 (3)
Exercise Physiology	10	1981–1990 (2) 1991–2000 (1) 2001–2008 (7)
Facilities	2	1991–2000 (1) 2001–2008 (1)
Measurement and Assessment	2	1981–1990 (2)
Motor Skills	6	2001–2008 (6)
Participation	1	2001–2008 (1)
Psychological & Social Aspects	8	1991–2000 (2) 2001–2008 (6)
Psychomotor Development	2	1971–1980 (1) ND (1)
Physical Fitness	4	2001–2008 (4)
Physician's Attitudes	2	2001–2008 (2)
Safety	1	2001–2008 (1)
Teacher Training	4	1991–2000 (1) 2001–2008 (3)
Teaching/Learning of Skills	6	1951–1960 (1) 1961–1970 (2) 1991–2000 (1) 2001–2008 (1) ND (1)

Note. Categorization by topic may not reflect all possible topics represented in the research. In many cases, an article could have been grouped into any of several topic categories. The most predominant topic was selected for categorization. These categories were not predetermined. Rather, they resulted from analysis of the research found following the search.

researchers. As evidenced in the work by Lea (1966), Shafter (1970), and Woitovich (nd), as well as Wieser (2007), facilitating aquatic participation for individuals with cognitive disabilities (mental retardation) is a more prominent continuing area of investigation.

Content Distribution of Articles

Distribution of research content spans many categories. The greatest amount of research regarding aquatics for individuals with disabilities appears to have taken place in the areas of *Exercise Physiology* and *Exercise Performance*. As profes-

Table 3 Article Distribution by Disability Population, Frequency, and Decade

Disability Population	Number of Articles	Decade
Alzheimer's	1	2001–2008 (1)
Arthritis	2	2001–2008 (2)
Asthma	1	2001–2008 (1)
Autistic	2	1981–1990 (1) 2001–2008 (1)
Cardiac	1	2001–2008 (1)
Cerebral Palsy	1	2001–2008 (1)
Dermatitis	1	2001–2008 (1)
Epilepsy	1	2001–2008 (1)
Fibromyalgia	7	2001–2008 (7)
Larynjectomy	1	2001–2008 (1)
Lymphodema	1	2001–2008 (1)
Multiple Sclerosis	1	1981–1990 (1)
Mental Retardation* (Cognitive Disability)	7	1961–1970 (3) 2001–2008 (2) ND (2)
Parkinson's Disease	1	2001–2008 (1)
Sensitive Limbs	1	1981–1990 (1)
Spinal Cord Injury	1	1991–2000 (1)
Traumatic Brain Injury	2	2001–2008 (2)
Visual Impairment	3	1951–1960 (1) 1991–2000 (1)
Disability Population not Differentiated	26	1981–1990 (6) 1991–2000 (5) 2001–2008 (15)

**Note.* "Mental Retardation" terminology is used here as that is the terminology used at the time of the research published. However, today the more appropriate term is "cognitive disability."

sionals recognized the ability of individuals with disabilities to engage in aquatic activities, documenting the benefits of that participation expanded as a research focus. During the 1980s, published research documenting the physiological effect of aquatic participation on low back pain (Woods, 1989) and on bone structure (Maleskey, 1987) emerged. Midtlyng (1988, 1990) contributed research on aquatic exercise, and Osinski (1989) investigated the impact of water running. The addition of aquatic exercise and water running to the literature on aquatics for individuals with disabilities broadened this category and heralded a new era of expansion in the field. Most recently, the effects of aquatic participation on disability specific populations is gaining in frequency, as evidenced by the investigation of aquatic exercise participation on individuals with fibromyalgia (Evcik, 2008; Gangaway, 2006; Gowans & deHueck, 2007).

In more recent decades, individuals with disabilities also increased their presence in competitive aquatics, prompting additional research threads in that category. For individuals with visual impairment, research in signaling devices brought improvements in orientation to swimming in lanes (Scheib & Ponchillia, 1999). Research by Chatard and colleagues (1992) documented the psychological aspects of competitive swimming for individuals with disabilities, and Martin and Adams-Mushett (1995) investigated athletic identity of swimmers with disabilities.

Motor Development and *Measurement and Assessment* are two closely related research areas. Killian, Joyce-Petrovich, Menna, and Arena (1984) and Killian, Arena-Ronde, and Bruno (1987) investigated orientation of atypical swimmers, as well as specific aquatic skills developed in children with autism. Recognizing skill acquisition is often linked to motor development researchers, such as Getz, Hutzler, and Vermeer (2005a, 2005b), Labudova (2007), Tirosh, Katz-Lauerer, and Getz (2008), and all have sought links to measuring aquatic skills as related to child development.

Viewing this content distribution in light of a span of over 50 years, one might be led to observe that research in aquatics for individuals with disabilities has been more than a bit random. That is indeed the case. No specific research threads were prominent over time or through content.

Disability Focus of Articles

Expanding our analysis to look at distribution of research by disability population does not improve the situation relative to prominent themes or topical threads. Fully 43% of identified research (26 out of 60 studies) is not disability specific. Interestingly, research on aquatic participation by individuals with mental retardation, done predominantly before the year 2000, is equal in number (seven studies) to research on fibromyalgia, done predominantly between 2001 and 2008. Other disability population specific research, while representing an additional 16 disability populations, was not completed in a significant enough quantity to draw conclusions. Rather, focus on any particular disability group appears to be at the discretion of the individual researcher.

Early focus on individuals with mental retardation can partially be explained by the time correspondence with increased focus on education for these individuals, who before the 1960s may not have been viewed as being capable of learning

swimming skills. However, if lack of prior educational focus is to be a consideration in selection of research topic, other disability populations which have emerged more recently, such as autism, learning disability, and/or neurobiological disorders, should have captured a similar research focus. To the contrary, this has not occurred.

Conclusions

Very little in the way of specific conclusions can be drawn from such a small amount of research data being published over a period of over 50 years, striving to include all areas of aquatics for individuals with disabilities. A few general conclusions might be obtained regarding the definition of aquatics for individuals with disabilities, research design, trend shifts, and specificity of research.

Defining the Field

Identifying medical research that uses water or a water environment is relatively clear, especially from publication venues and author credentials/affiliations. It was relatively easy to sort out the medical research from aquatics for disabilities research. What remained after exclusion of medical research was far ranging in disability population, general population demographics, and type of aquatic activity. No research pattern regarding aquatic activity engagement was discernable.

Research Design

Once medical research had been excluded, research design and quality of the research became an issue. Periodical publications represented included a wide scope of focus, and in some cases, no criteria existed for use of the term *research* or qualifications of persons reporting research. If strict application of the term "research," with some type of inferential statistical verification of results, had been used for this review, very few articles would have survived this evaluation.

Trend Shifts

There does appear to have been a shift from focusing on how individuals learn swimming skills, particularly individuals with cognitive disability, as represented by research in the 1960s and 1970s, to a focus on health benefits, not just on general health and fitness, but on health benefits for specific disability populations. A second shift seems to have taken place from learning swimming skills to the effects of aquatic exercise in a broad context. This mirrors the growth in aquatic exercise and fitness programs.

Specificity of Research

Lack of a significant amount of research in any particular area of disabilities or aquatic endeavors was evident in my review. Research topics appear to reflect individual researcher interest, rather than a professional field imperative. The Table 4reflects this scattered approach to the research. All topics, as represented in

the left column, indicate a topic as specifically related to individuals with disabilities participating in some form of aquatic activity. Some research could fall into more than one category; however, the primary focus was used for this summary.

Recommendations

As a profession, aquatic professionals who engage in research must put more focus on aquatics for individuals with disabilities. Cuts in funding for aquatic facilities and programming, increasing health care costs, and disability specific health concerns all could be better addressed if the beneficial effects of aquatics for individuals with disabilities was documented more extensively with well defined lines of research inquiry. We must empirically prove the value of aquatics for individuals with disabilities. The many anecdotal success stories outside the

Table 4 Scatter Distribution of Research Topic

	1930–1959*	1960–1969	1970–1979	1980–1989	1990–1999	2000–2008	Undated
Aquatic Exercise	0	1	0	3	1	3	0
Cognition/Brain Function	0	0	0	0	0	1	0
Competition/Elite Athlete	0	0	0	0	0	1	0
Equipment	0	0	0	0	2	0	0
Facilities	0	0	0	0	1	1	0
Measurement/ Assessment	0	0	0	2	0	0	0
Motor Development	0	0	0	0	0	6	0
Participation	0	0	0	0	0	1	0
Physical Fitness	0	0	0	0	0	4	0
Physician Attitudes	0	0	0	0	0	2	0
Physiology	0	0	0	2	1	7	0
Psychological/ Social Benefit	0	0	0	0	2	6	0
Psychomotor Development	0	0	1	0	0	0	1
Safety/Risk Management	0	0	0	0	0	1	0
Teacher Training	0	0	0	0	0	4	0
Teaching/Learning Skills	0	2	1	0	0	2	1

*1930–59 was included in the data presentation because this time period was included in the parameters of the original review of literature.

realm of published research have more than proved individuals with disabilities can succeed in aquatic activities and that aquatic activities are extremely valuable for individuals with disabilities. We know individuals with disabilities can and should participate. What we need to obtain now is quality research data to justify the following:

- Setting higher priorities for facility use by individuals with disabilities
- Increasing program funding allocation for aquatic programs for individuals with disabilities
- Obtaining insurance reimbursement for participation by individuals with disabilities in aquatics as a wellness activity
- Allowing insurance reimbursement for aquatics as part of all rehabilitation programs where not medically contraindicated
- Justifying facility modifications necessary for access by everyone.

We need research to determine effects of the following:

- Vigorous aquatic exercise on metabolism of individuals in any number of a variety of disabilities—diabetes, obesity, asthma, fibromyalgia, sickle cell anemia are only a few
- Participation in structured aquatic activity on behavior and social interaction of individuals with a variety of behavior related disabilities—autism syndrome disorders, psychological problems, behavior management issues, for example
- Various competitive training programs on the performance of elite level swimmers with disabilities
- Aquatic activity on pain reduction for any number of acute, as well as chronic, conditions
- Aquatic participation on health and wellness of individuals in every general disability category
- Various water and air temperatures on aquatic participation of specific disability population groups
- Pool chemical configurations—bromine vs. chlorine vs. saline on aquatic participation of specific disability population groups
- Infection control during aquatic participation related to specific disability populations where contamination and/or infection could be an issue related to on-going participation.

The above list could be considerable longer. These topics are just a few examples of topics desperately needing intensive research examination. Unfortunately, we can no longer make something happen because we believe it is good, right, or beneficial. Monetary considerations make providing evidenced based research an imperative for any organizational or administrative change to take place. We must be able to prove what we claim.

A research imperative will require partnerships between research institutions and community programs. Most community aquatics professionals do not have the research design statistical, or writing background to conduct, evaluate, and publish significant research. Investigators at research institutions, for the most

part, are not encouraged and therefore usually do not seek to conduct research focused on aquatics for individuals with disabilities because this is not a population group that is readily available within institutions of higher learning. Sixty research studies out of 909 published items over 50 years do not constitute a body of knowledge in a field with as many participants with disabilities as there are today. Decades ago, we might speculate this was because individuals with disabilities were not participating in aquatics. We know this is not the case today. The widely- varied and scattered research topics found in this review and in the database indeed tells us people with disabilities are participating. Researchers are just not addressing this population as a research target.

Possible research topics are almost endless when one considers the number of different acute as well as chronic disabling conditions, the range in age of participants, the level of resulting disability, and the scope of the activity offerings in the field of aquatics. Specific focus areas, in the mind of this author, might include the following:

- Effects of early intervention with water learning activities on academic achievement of children with disabilities.
- Differences in beneficial effects of among aquatic exercise, water jogging, and water walking for specific disability population groups.
- In-water measures of motor ability, physical fitness, and perceptual-motor function, making assessment in the aquatic medium as beneficial as assessment on land.
- Effects of specific aquatic exercises and activities such as Bad Ragaz, WATSU, Ai Chi, and Halliwick on specific problems of individual disability population groups.
- Long term effects of aquatic participation on maintenance of health and wellness during periods of acute disability.
- Drowning causation and death rates for specific disability population groups.
- Rescue and resuscitation techniques for disability populations where the type or severity of the disability might affect the outcome of a traditional rescue and/or resuscitation effort.
- Performance parameters of elite competitors among aquatic competition for individuals with disabilities.

Lastly, we can only speculate why there has not been a greater emphasis on research on aquatics for individuals with disabilities. We do know that more research is needed. For research of this type to be possible, however, we must be prepared to modify our population sampling criteria, our research designs, and our statistical analyses. Research in aquatics for individuals with disabilities will not be inclusive of hundreds of individuals in a single study. Due to the wide distribution in any disability subpopulation, working with a large, matched-pair group will be almost impossible. As a profession, we must give credence to research studies with small samples and less than perfect population matching. In effect, we must work with the participants who we have, in the best way we can, to obtain relevant information. It is time we put an end to just saying how wonderful it is for an individual with a disability to participate in aquatics. We must start

describing in very specific, research justified terms why that participation is not only wonderful, but also very necessary for health and wellness.

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